North Zone Roadside Salvage Project

Noxious Weeds Report

Prepared by:

Jennifer Costich-Thompson
Botanist
IPNF North Zone

March 10, 2011

Table of Contents

Introduction

This report discusses the environmental effects of implementation of the North Zone Roadside Salvage (NZRS) Project on noxious weeds. A summary of this report is included in the environmental assessment (EA) as part of the Affected Environment and Environmental Consequences section.

The Forest Service Handbook (FSH 3409) defines a strategy for managing pests, including noxious weeds, as "a decision-making and action process incorporating biological, economic and environmental evaluation of pest-host systems to manage pest populations" (FSH 3409.11, 6/86). This strategy is termed Integrated Pest Management (IPM).

The overall Idaho Panhandle National Forests (IPNF) strategy is to contain weeds in currently infested areas and to prevent the spread of weeds to susceptible but generally uninfested areas. The 1989 IPNF Weed Pest Management EIS describes the strategy. Weed management activities in the North Zone (Kaniksu) of the IPNF are guided by respective noxious weed control management strategies on the three districts comprising the North Zone: Sandpoint Ranger District, Priest Lake Ranger District, and Bonners Ferry Ranger District.

Noxious weeds are those plant species that have been officially designated as such by federal, State or county officials. In Weeds of the West by Whitson et al. (1991), a weed is defined as "a plant that interferes with management objectives for a given area of land at a given point in time." The federal Noxious Weed Act of 1974 defines a noxious weed as "a plant which is of foreign origin, is new to, or is not widely prevalent in the United States, and can directly or indirectly injure crops or other useful plants, livestock or the fish and wildlife resources of the United States or the public health" (P.L. 93-629).

The Idaho Noxious Weed Law defines a "noxious weed" as any exotic plant species established or that may be introduced in the State which may render land unsuitable for agriculture, forestry, livestock, wildlife or other beneficial uses and is further designated as either a statewide or countywide noxious weed (Idaho Code 24 Chapter 22).

Both federal and state laws define weeds primarily in terms of interference with commodity uses of the land. However, the impacts of noxious weeds on non-commodity resources such as water quality, wildlife, and natural diversity are of increasing concern.

Regulatory Framework

Federal legislation, regulations, policy, and direction that require development and coordination of programs for the control of noxious weeds and evaluation of noxious weeds in the planning process include the following:

National Forest Management Act (NFMA) (1976)

National Environmental Policy Act (NEPA) (1969)

Forest Service Manual (Chapter 2080, as amended) (USDA 2001b)

Executive Order #13112 (1999)

IPNF Forest Plan (1987)

IPNF Weed Pest Management EIS (1989)

Bonners Ferry Noxious Weed Management Project EIS (1995)

Priest Lake Ranger District Weed Control Project EIS (1997)

Sandpoint Ranger District Noxious Weed Control Project EIS (1998)

Existing Condition

Methodology

Information on current weed infestations and results of weed management in the project area is derived from records of previous weed treatments, weed monitoring, and from observations during botanical field surveys.

Documented Noxious Weed Infestations

Documented weed species in the project area include the following:

Species	Infestation Level*	State Ranking
spotted knapweed (*Centaurea stoebe* L.)	moderate	Contain
Canada thistle (*Cirsium arvense* [L.] Scop.)	low	Contain
St. Johnswort (*Hypericum perforatum* L.)	moderate	Contain
meadow hawkweed (*Hieracium caespitosum* Dumort.)	low	Control
orange hawkweed (*Hieracium aurantiacum* L.)	low	Control
oxeye daisy (*Leucanthemum vulgare* L.)	low	Contain
sulfur cinquefoil (*Potentilla recta* L.)	low	Unlisted by State
common tansy (*Tanacetum vulgare* L.)	low	Unlisted by State

* A description of weed infestation levels is included in the project file

These species primarily occur along Forest roads in the project area. Spotted knapweed and St. Johnswort also occur in natural openings in the project area, but off-road weed infestation levels are generally low overall and are scattered.

Because spotted knapweed and St. Johnswort occur off-road in areas proposed for treatment, they are of greater concern than roadside infestations where active controls are more feasible.

Noxious Weed Species of Concern in the Project Area

Spotted Knapweed (*Centaurea stoebe* L.)

Spotted knapweed is native to Eastern Europe. It was introduced to North America, probably as a contaminant in alfalfa seed and/or ships' ballast, in the late 1800s (Maddox 1979, Ochsmann 2001, Roche et al. 1986). In 1920, its distribution was limited to the San Juan Islands in Washington. By 1980, it had spread to 48 counties in the Pacific Northwest, and by 1998 its known range included every county in Washington, Idaho, Montana and Wyoming (Sheley et al. 1998).

Spotted knapweed is a perennial species that reproduces almost entirely from seed, although some plants extend lateral shoots below the soil surface that form new rosettes. It establishes and dominates on dry, disturbed sites, especially along roads (Roche et al. 1986). It also invades relatively undisturbed perennial native plant communities in the northern intermountain region (DiTomaso 2000).

Most studies of spotted knapweed to date have focused on its dominance of native grasslands and/or prairies (Tyser and Key 1988, LeJeune and Seastedt 2001, Ridenour and Callaway 2001). Much of spotted knapweed's dominance over native species in those habitats may be attributed in part to root allelopathy (Ridenour and Callaway 2001). Increased availability of nitrogen in what were historically nitrogen-limited habitats that favored native grass species, and the resulting creation of phosphorus and other resource limitations in grassland soils, may also be a factor in spotted knapweed's success in grassland habitats (LeJeune and Seastedt 2001). LeJeune and Seastedt (2001) hypothesize that manipulation of soil resource availability with traditional techniques such as fire can affect the dominance of invasive species such as Centaurea in grassland habitats.

In contrast, the NZRS project area is largely dominated by moist and mesic to dry forested habitats with a high shrub component. Non-forested habitats comprise a small portion of the project area (see Vegetation section of the EA). While the behavior of spotted knapweed in open grassland habitats may be mostly influenced by the above biotic factors, in forested habitats tree and shrub layer canopy cover is likely a major limiting factor.

Knapweed seeds are able to germinate under full canopy, but mature plants are uncommon in shaded areas (Watson and Renney 1974); it is typically found in open canopies, sometimes up to 20 percent but most often under canopy cover of five percent or less (Allen and Hansen 1999). Both tree and shrub canopy cover have been observed to affect the abundance of spotted knapweed in forested habitats similar to those in the NZRS project area (Hammet personal observations 1999-2005).

One study considered the effects of spotted and diffuse knapweed on the growth of conifer seedlings in a montane forest in southern interior British Columbia (Powell et al. 1997). The results of the study were that abundant knapweed growth did not negatively impact conifer growth and survival during the three-year study period. While Powell et al. (1997) concluded that the lack of effects to conifer seedling growth was likely due to abundant moisture levels during the study period, only the interaction between conifer seedlings and knapweed was measured - all other vegetation had been removed from the site and was cleared every season (Powell et al. 1997). Other site variables such as availability of light were therefore not considered.

The habitats in which spotted knapweed now occurs had historical fire regimes of relatively frequent, low-severity surface fires to mixed-severity fires. Spotted knapweed established in most of these habitats after fire exclusion began, so it is unclear how historical fire regimes might affect spotted knapweed or how spotted knapweed may affect these fire regimes (Fire Effects Information System 2008).

Low-severity fire typically does not kill spotted knapweed plants or seeds (Sheley and Roche 1982). According to LeJeune and Seastedt (2001), low-severity fires in grasslands may increase the availability of nutrients that would allow native species to successfully compete with spotted knapweed. Although severe burns may reduce germination of spotted knapweed seeds (Abella and MacDonald 2000), severe wildfire would probably favor expansion of knapweed by creating

widespread areas of bare soil and increasing the amount of sunlight that reaches the ground surface (Arno 1999, Sheley et al. 1999). Spotted knapweed infestations have been associated with reductions in forage production (Harris and Cranston 1979), plant species richness and diversity (Tyser 1990), soil fertility (Harvey and Nowierski 1989, Olson 1999) and wildlife habitat (Bedunah and Carpenter 1989), as well as increases in surface water runoff and stream sedimentation (Lacey et al. 1989).

Hawkweed species (*Hieracium caespitosum* Dumort & *H. aurantiacum* L.)

Introduced from Europe as an ornamental plant, meadow hawkweed (*Hieracium caespitosum*) can be found in moist grasslands, forest meadows, abandoned fields, clear cuts, roadsides, established lawns and gardens. Once introduced into an area, it can quickly form dense patches. If not controlled, these patches can expand into large areas and displace desired native and forage species (Idaho Weed Awareness Campaign 2011).

Little information is available regarding meadow hawkweed's response to fire. Meadow hawkweed has been documented in burned areas following both wildfire (Anzinger and Radosevich 2008) and prescribed fire (Hanks 1971, Medve 1984, Mohlenbrock 1986). Meadow hawkweed exhibits some characteristics that make it likely to survive and/or establish after fire. Belowground rhizomes and adventitious root buds likely survive fire. Rhizomes, adventitious root buds, and stolons reportedly sprout after physical disturbance (NDDA 2007, Wilson and Callihan 1999), suggesting that postfire sprouting is possible. Meadow hawkweed seeds do not seem to persist in the soil seed bank. High-light conditions may favor meadow hawkweed sexual reproduction and vegetative regeneration (Carson and Root 2000).

St. Johnswort (*Hypericum perforatum* L.)

St. Johnswort (also known as goatweed) is native to Europe, western Asia and North Africa. It was likely introduced to North America multiple times (Maron et al. 2004). The first recorded occurrence of the species in North America was from Pennsylvania in 1793; by the early 1900s it was established in many western states (Sampson and Parker 1930). Goatweed population levels were dramatically reduced following a successful biological control program begun in the 1940s in heavily infested regions of the western United States (Tisdale 1976).

St. Johnswort is a perennial species that reproduces both by seed and by often extensive lateral root growth that produces additional aerial crowns. In forested areas, it is commonly associated with disturbances such as roads, logging, grazing and fire. Where it occurs in forest zones in Idaho, it is abundant only in small, localized areas in naturally open ponderosa pine stands or where tree cover has been greatly reduced by logging, fire or other disturbance (Tisdale et al. 1959). Several studies suggest that goatweed requires abundant light for best development. In one study, plants subjected to 50 percent of full daylight almost all died after 15 days (Sampson and Parker 1930). More recent studies corroborate those findings (Parendes and Jones 2000). Both tree and shrub canopy cover have been observed to affect the abundance of goatweed in forested habitats similar to those in the NZRS project area (Hammet personal observations 1999-2005).

The historic fire regimes of habitats in which St. Johnswort occurs, range from relatively infrequent, high-severity fires in wet forest types to high-frequency, low-severity fires in dry forest types. The species established in most of these habitats after fire exclusion began, so it is unclear how historical fire regimes might affect St. Johnswort or how it may, in turn, affect these fire regimes (Fire Effects Information System 2008).

While it is generally purported that fire encourages establishment, vegetative spread and increased density of St. Johnswort patches (Campbell and Delfosse 1984), the variation in the species' response to fire from study to study may reflect differences in plant community type, fire size and severity and/or season of burning. One 1975 study in north Idaho did not show any obvious changes in St. Johnswort infestations following spring burning of brush-covered slopes and seeding with non-native herbaceous species. St. Johnswort seedlings are susceptible to competition from other species; multiple stresses such as defoliation by biological control agents and fire may also cause reductions in crown density of mature plants (Briese 1997).

St. Johnswort is well known for its medicinal and other commodity uses. However, hypericin, a chemical constituent of St. Johnswort, causes photosensitization in animals that consume it; the effects of poisoning can lead indirectly to death. Its impact on native plant communities may not be as great as earlier literature seems to indicate, perhaps due to the moderate success of biological control efforts over the last 60 years (Fire Effects Information System 2008). The most commonly described impacts are loss of forage production and carrying capacity on rangelands and losses from livestock poisoning (Ruggiero et al. 1991).

Oxeye Daisy (*Leucanthemum vulgare* L.)

Oxeye daisy is a European native that has spread to become a weed in 40 countries, from Africa to Australia and North and South America. Oxeye daisy is designated by the State of Idaho as a noxious weed with a priority of "Containment" (ISDA 2011b).

Oxeye daisy can survive over a wide range of environmental conditions. It is common in native grasslands, overgrazed pastures, waste areas, meadows, railroad rights-of-way, and roadsides. The species can grow on a wide range of soils, especially those low in pH and nutrients (Holm *et al*. 1997; Howarth and Williams 1968; Olson and Wallander 1999). In Europe, oxeye daisy is found up to 70° north and 3300 feet in elevation.

Most ox-eye daisy seeds remain viable for twenty years in the soil, and can remain viable after passing through digestive tracts of animals (CAL-IPC 2011). The effects of prescribed fire on this species have not been studied (CAL-IPC 2011).

Common Tansy (*Tanacetum vulgare* L.)

A native of Europe; common tansy was first introduced to North America for medicinal purposes and as an ornamental plant (USDA Forest Service 2005). It grows in sandy and loamy soils of open disturbed areas, roadsides, pastures, fields, prairies, hedgerows, gardens and naturally disturbed environments, such as flood-scoured river shores (USDA Forest Service 2005). Common tansy may threaten ecosystem health through reduction of wildlife habitat and species diversity.

Although seed dispersal may be the primary method for long-distance spread, common tansy regenerates from rhizome fragments (CWMA 2009, MDNR 2003, WDNR 2008) that can be dispersed by soil movement or equipment (CWMA 2009, Hilty 2009, Jacobs 2008). Common tansy seed viability in the seed bank is largely unknown (CWMA 2009), but speculation suggests a short-lived seed bank.

Common tansy is likely only top-killed by fire (Jacobs 2008). On sites with established common tansy plants, postfire sprouting from rhizomes is likely the predominant regeneration method. Because common tansy seeds can be dispersed long distances and seedlings establish best on sites with bare ground, little established vegetation, and high light levels (Kleijn 2003, White1997),

burned areas could provide suitable establishment sites. Studies documenting common tansy recovery, establishment, and/or increases or decreases in abundance on burned sites are lacking. However, some sources suggest that burning may provide habitat suitable for seedling establishment (Elpel 2009, Jacobs 2008). These sources suggest that fire may result in increased abundance or facilitate spread of common tansy.

Current Weed Management Efforts

Many of the Forest System Roads and trails within the project area were specifically identified for treatment in either the Sandpoint, Priest Lake, or Bonners Ferry Ranger District noxious weed control FEIS (USDA 1995, USDA 1997, and USDA 1998.) A complete list of those roads and trails treated within the project area is in the project file.

Spotted knapweed and St. Johnswort are considered naturalized in northern Idaho and scattered throughout the project area. Management of these species will emphasize reducing infestation levels and slowing their rate of spread. Biological control agents for knapweed (*Metzneria paucipunctella*, *Urophora affinis* and *U. quadrifasciata*) are established in Idaho (Rees et al. 1996) and have been identified in the project area. The biological control agent for St. Johnswort, *Chrysolina quadrigemina*, was first released in the United States in 1946 and is now well-established in Idaho (Rees et al. 1996); it too, has been identified in the project area. Additional biological control agents for St. Johnswort and knapweed may be released in the project area as appropriate and as prescribed in the pertinent noxious weed control or management plan.

Meadow and orange hawkweed, oxeye daisy, sulfur cinquefoil and Canada thistle are currently established but are not considered naturalized in the project area. They are largely confined to Forest roads in the project area. Infestations will be monitored and contained, with eradication where feasible.

Of major concern are potential new invaders (see project file) not yet documented in the project area. In accordance with guidelines in the Northern Region Overview (USDA 1999), management priorities emphasize identification and eradication of tansy ragwort, leafy spurge and yellow starthistle. Some additional weed species listed as noxious in Bonner or Boundary Counties and recorded as occurring there have not yet been documented in the project area. These species would be a high priority for eradication if any individuals were observed during operations or monitoring in the project area.

The inclusion of weed treatment and prevention practices in timber sale contracts since 1998 and increased funding for weed treatment have increased the likelihood of success in containing and reducing weed infestations throughout the district.

Environmental Consequences

Methodology

Analysis was conducted based on current distribution of weed species in habitats similar to those found in the proposed treatment areas and on the types of proposed project activities. The estimation of risk of weed spread and introduction of new weed invaders from the proposed activity is based on peer-reviewed literature, professional judgment, as well as experience in the project area and on similar sites in the IPNF.

Effects of proposed actions on noxious weed spread are dependent upon the amount of forest canopy removal and the degree of soil and/or understory vegetation disturbance. As described earlier with many noxious weed species, greater forest canopy removal equates to more sunlight reaching the forest floor. More sunlight reaching the forest floor creates more favorable conditions in which noxious weeds can grow and dominate. From personal observations, when forest canopy cover is greater than 20 percent, noxious weed cover is less abundant and does not typically expand (Hammett, personal observations 1999-2005.)

Generally ground-based logging creates more soil disturbance than skyline or helicopter harvest, not only because during ground-based logging operations the yarded logs or are not fully suspended off the ground, but also because typical ground-based logging involves the use of off-road equipment. Off-road equipment has the potential to cause severe soil disturbance depending upon soil conditions, and potential damage can include soil displacement, compaction, rutting, and exposure of bare, mineral soil. However, the harvest activities proposed with the NZRS project do not include any off-road equipment use. In effect, the only soil disturbance created by the proposed project would be the result of log skidding or cabling, where a log is pulled with one or more points of contact along the ground. As a result, the potential soil damage caused by the NZRS project is far reduced from a typical ground-based logging operation.

Because the NZRS project only proposes salvage harvest of dead or down logs or those trees which pose a hazard to the road, the intensity of harvest and skidding will be very low. In fact, in many places the harvest will not exceed what already occurs resulting from permitted, private firewood cutting. Dead, down timber does not contribute to the overall forest canopy cover, and standing, dead snags only contribute negligible shading in the forest canopy. Therefore, removal of these features and limited numbers of live, hazard trees, as proposed in the NZRS project, will result in only a slight decrease in forest canopy cover. Therefore, the expected impacts of the NZRS project on weed spread or new weed introduction into treated areas is predicted to be very low.

The cumulative effects analysis area describes the area beyond which effects of the proposed project cannot be detected. Determination of the cumulative effects area for weeds considered the extent of currently documented weed infestations and likely seed dispersal distances. While patterns of dispersal are not known with certainty for many plant species, in studies of *Botrychium virginianum* most spores fell within three meters of the source plant (Peck et al. 1990). Noxious weed species' seeds that are heavier than *Botrychium* spores might be assumed to have similar if not more restricted dispersal patterns. Transport of weed seeds out of the project area is possible, with occasional transport over long distances (such as on vehicles). However, it would be difficult to predict the extent of such long-distance dispersal. It is likely that most seeds of noxious weeds would fall close to the parent plant.

In addition, road systems and lands adjacent to the project area have noxious weed infestations similar in composition and distribution to those in the project area, so transport of weed seeds to these lands from the project area would have little additional impact. For these reasons, the cumulative effects analysis area for noxious weeds is the project area.

Cumulative effects with regard to noxious weeds from proposed activities are generally described as very low, low, moderate or high, with the following definitions:

- *very low* = no measurable effect on existing weed infestations or susceptible habitat
- *low* = existing weed infestations and/or susceptible habitat not likely affected
- *moderate* = existing weed infestations or susceptible habitat affected, with the potential for expansion into uninfested areas and/or establishment of new invaders
- *high* = weed infestations and/or susceptible habitat affected, with a high likelihood of expansion into uninfested areas and/or establishment of new invaders.

The period for measuring short-term cumulative effects to noxious weeds and susceptible habitat is ten years following completion of the proposed activities, or, in the event of selection of the No Action Alternative, ten years after the date of the signing of the Decision Notice and FONSI. The ten-year period is based on the expected recovery and/or establishment of desired species in disturbed areas. Long-term effects to noxious weeds from loss of canopy cover are addressed below.

The following past, current, ongoing and reasonably foreseeable events apply to the cumulative effects analysis for noxious weeds:

Past Activities and Events

- Large wildfires (numerous stand-replacing fire events, including 1910, 1922, 1926-1931)
- Timber harvest on NFS lands
- Mining activities on NFS lands
- Timber harvest on other ownership lands
- Road and trail construction
- Development on private lands
- Wildfire suppression

Current and Ongoing Activities

- Road and trail maintenance
- Wildfire suppression
- Defensible space projects on private lands
- Development on private lands
- Recreational use on NFS lands

Reasonably Foreseeable Actions

- Noxious weeds monitoring and treatment

Design Features

The Issues and Alternatives chapter of the environmental assessment includes the following required mitigation for noxious weeds:

- Noxious weed treatment would be conducted according to guidelines and priorities established in the appropriate district's noxious weed control policy: Bonners Ferry

Noxious Weed Control Project FEIS (USDA 1995), Priest Lake Ranger District Noxious Weed Control FEIS (USDA 1997), or Sandpoint Noxious Weed Control Project FEIS (USDA 1998). Methods of control may include biological, chemical, mechanical and cultural. Follow-up treatments and monitoring would be conducted as needed.

- Any gravel or rock utilized for road reconstruction or maintenance activities associated with this project must be obtained from a State- Certified Weed Free source or a Forest Service- authorized weed treated source that is free of new weed invaders. A list of weed species considered to be potential new invaders is included in the project file.
- Any priority weed species (as defined by the IPNF Weed Specialist) identified during road maintenance or roadside salvage activities would be reported to the District Weed Specialist. A list of priority weed species is included in the project file.
- Monitoring of all haul routes and service landings on NFS lands would occur during project implementation, with treatment of identified weed infestations as needed and authorized under each district's noxious weed control policy.
- Where feasible, weed treatment of all haul routes and service landings on NFS lands would occur prior to ground disturbing activities, as authorized under each district's noxious weed control policy. If the timing of ground disturbing activities would not allow weed treatment to occur when it would be most effective, it would occur in the next treatment season following the disturbance.
- All timber sale contracts would require cleaning of harvest and road reconstruction/ maintenance equipment prior to entry onto NFS lands.
- If operations occur in areas infested with new noxious weed invaders (as defined by the IPNF Weed Specialist), all equipment would be cleaned prior to leaving the site.
- All landings or other areas of disturbance (including maintenance and reconstruction of existing road cutbanks and fill slopes) would be seeded with the most current IPNF site-appropriate, certified, weed-free seed mix. Revegetation species utilized should be source-identified, site-appropriate, and genetically-adapted to the project area, when feasible. Areas that are incur fuels treatment or slash burning would be evaluated by the North Zone Botanist or Forest Soil Scientist after the burn and seeded/revegetated and fertilized as necessary.
- All mulch materials used for seed or soil stabilization would be certified weed-free.

Estimated Effectiveness

The above mitigation measures are accepted weed prevention practices developed by public land management agencies and university cooperative extension offices and promoted by weed management organizations across the nation (e.g. Sheley et al. 2002, Drlik et al. 1998, USDA 2001a). The above measures include those required in Forest Service Manual (FSM) 2080 for activities related to timber harvest and roads. They are described in FSM 2981.2- 1a and FSM 2081.2 - 6a, respectively (see project file). Also included are weed prevention practices recommended but not required (see project file).

For new weed invaders, the estimated effectiveness of the above measures is high; the measures are expected to be very effective at preventing establishment of new invaders. According to current research (Hobbs and Humphries 1995), early detection and treatment of infestations before explosive spread occurs can significantly reduce the social cost of weed invasions.

For existing infestations that occur along road rights-of-way, estimated effectiveness is moderate; the measures are expected to be somewhat effective at reducing the spread of these into

previously un-infested portions of the project area. For existing infestations that have spread off the road, estimated effectiveness is low. Effectiveness of treatments on NFS lands could be even more reduced if adjacent landowners do not treat their weed infestations. Existing weeds and new invaders are also spread by wildlife, winds, water and hikers – the mitigation measures would have no effect on these sources of weed spread.

Required Monitoring

In addition to design features (described above and in Chapter 2 of the EA), certain monitoring is required for the implementation of the NZRS project, as described below.

IPNF Forest Plan Monitoring

According to the Forest Plan, "many noxious weed species (knapweed, goatweed, thistle, tansy, etc.) are widespread, and…major programs to eradicate such species are not possible within expected budget levels". IPNF direction is to give priority to small infestations of "species new to an area, where moderate control actions have a good chance of preventing the establishment of new problems." Noxious weed control will be based on an integrated pest management approach.

Project Monitoring

Pretreatment of roads and equipment as proposed (Features Common to All Action Alternatives) would be documented on sale inspection reports. The effectiveness of seeding disturbed areas would be evaluated upon completion of the activity. Treated areas would be surveyed and monitored according to treatment priorities established in the appropriate district's noxious weed control policy (USDA 1995, USDA 1997, USDA 1998.)

Effects Common to Alternative 1 (No Action), Alternative 2 (Preferred Alternative), Alternative 3 (No Roadside Salvage, but Road Maintenance with Utilization), and Alternative 4 (Roadside Salvage, but only limited Utilization with Road Maintenance)

Direct and Indirect Effects

With implementation of any alternative, seeds from any weeds on private and Forest System Roads and NFS lands in the project area may still be transported within and out of the area by vehicles, people, birds, wildlife, wind, and even potentially free-flowing water. Untreated weed infestations on private lands in the project area could spread to public lands.

Cumulative Effects

Existing Infestations

Cumulative effects with regard to existing weed infestations are expected to be low to moderate under any of the four alternatives, considering the following:

Past Activities and Events

Past wildfires, mining activities, timber harvest and road and trail construction provided areas of soil disturbance and/or changes to vegetation and forest canopy cover, enabling invasion by non-

native plant species, including noxious weeds. Because of inadequate past weed prevention and control practices, the effects of these activities on noxious weed spread are still evident.

The loss of tree canopy cover from past timber harvest may have been a factor affecting weed spread in the project area. As the tree canopy in open stands closes, shade-intolerant weeds will, over the long term, be displaced. This process could take another 20-30 years or more. In areas with a high shrub component, recovery of the shrub canopy layer has been much quicker to affect the density of off-road noxious weed infestations in the project area (see the above discussion of the effects of canopy cover on spotted knapweed and goatweed).

Current and Ongoing Activities

Road maintenance activities may result in ground disturbance that would be conducive to the spread of existing weed populations. The current levels of weed treatment and monitoring on Forest System roads in the project area would help reduce the risk of weed spread from these activities.

As described in all four alternatives, road maintenance activities are managed by previous policy, and the effects of road maintenance from all four alternatives would therefore be the same. Under Alternative 1 (No Action), no roadside salvage activities would occur, and road maintenance activities would continue to occur in the project area as directed by prior management policies. Under Alternative 3, no roadside salvage activities would occur, and associated with the ongoing road maintenance, utilization of woody materials produced as a by-product of road clearing/brushing would be allowed. Under Alternative 2 (The Preferred Alternative) and Alternative 4, road maintenance would occur as in the other two alternatives, except with the addition of roadside salvage and varied levels of utilization along the road prisms (effects of which are described below in "Effects Common to Alternatives 2 and 4.) Effectively, road maintenance activities described under all of these alternatives would result in no soil disturbance or changes to forest canopy cover outside of the existing road prisms already in place. Therefore, with respect to effects of road maintenance activities on weeds, these four alternatives would result in the same effects.

Ongoing road maintenance activities have the potential to affect weeds in the project area through three modes. First, road maintenance equipment (although required to be effectively cleaned, as per Design Features for each alternative) has the potential to accidentally provide a vector from weed infestations outside the project area to previously un-infested lands within the project area. Second, soil disturbance intrinsic to road maintenance (blading, ditch-pulling, etc.) displaces existing vegetation and exposes bare mineral soil, creating suitable habitat for establishment of non-native species, including noxious weeds. Finally, the act of road maintenance along a road corridor has the potential to spread existing populations of weeds from one point along the road to new, previously un-infested areas.

Wildfire suppression will continue under all four alternatives. Such suppression efforts may have contrary effects on weeds in the project areas. First, fire suppression indirectly allows forest canopy and understory vegetation to accumulate, which could reduce the potential short-term habitat for noxious weeds. Long-term effects from fuel accumulation could include higher likelihood of high-intensity, stand-replacing fires, which could exacerbate weed introduction and spread. Should such a fire occur, it would likely cause existing infestations to spread to previously uninfested areas. It would also provide the disturbance that would allow dormant weed seeds in the soil to germinate. However, the occurrence and intensity of a future wildfire in the project area is difficult to predict.

Secondly, wildfire suppression efforts also usually include fireline construction (which exposes bare mineral soil) or firebreak construction (which usually through burning or mechanical vegetation removal both decreases forest canopy cover and also exposes bare mineral soil.) Both of these suppression tactics usually increase potential for weed spread.

Recreational use on public lands in the project area will undoubtedly continue regardless of alternative selection. Recreational use generally increases the potential for new weed introductions, as well as noxious weed dispersal and spread. Noxious weed education efforts at trailheads throughout the forest continue to serve as the only mitigation for this activity.

New Invaders

Under all four alternatives, cumulative effects with regard to new invaders are expected to be low when combined with Design Features (described on pages 11-12) and all of the above past, current, ongoing, and reasonably foreseeable actions. Proper implementation of Design Features should reduce the risk of new noxious weed invaders becoming established.

Reasonably Foreseeable Actions

Noxious weed treatment and monitoring would follow guidelines and priorities established in the commensurate district's noxious weed control policy (USDA 1995, USDA 1997, USDA 1998.) Treatment of Forest System roads in the project area would likely continue to protect previous investments. If appropriated funding is available, biological control agents may be released in off-road knapweed and St. Johnswort infestations in the project area. However, under Alternative 1 (No Action) no Knutsen-Vandenberg (KV) funding would be available for any weed treatment.

Determination of Cumulative Effects

When combined with all of the above activities and design features, cumulative effects to *existing weed infestations* resulting from road maintenance activities associated with any alternative are expected to be low. Small or isolated weed populations adjacent to the road prisms of oxeye daisy, common tansy, Canada thistle, sulfur cinquefoil, and hawkweeds in the project area will continue to be managed and controlled according to each district's noxious weed control policy. Off-road infestations of spotted knapweed and St. Johnswort in the project area are scattered, but much more naturalized than the other weed species observed in the project area. As a result, road maintenance activities associated with each alternative will have little effect on these populations.

When combined with all of the above activities and design features, cumulative effects to *new weed introductions or potential for new weed invader establishment* in the project area resulting from road maintenance activities associated with any alternative are expected to be very low.

Effects Common to Alternative 2— Road Maintenance with Utilization and Roadside Salvage (The Preferred Alternative) And Alternative 4—Roadside Salvage, Road Maintenance with Limited Utilization

Because the Alternatives 2 and 4 both include roadside salvage harvest, there is a greater potential of new weed introduction or weed spread outside of the road prisms than with Alternatives 1 and 3. The risks and potential for direct and indirect effects on weed spread associated with proposed activities of Alternatives 2 and 4 are discussed below.

Direct and Indirect Effects

Risk of Weed Spread from Project Activities

Alternative 2 and Alternative 4 both include the same prescription for roadside salvage harvest along approximately 430 miles of specifically listed and currently open, Forest System road segments. These roadside salvage activities will not involve use of off-road equipment. Instead, some dead, down timber will be cabled or winched to the road prism. Dead standing trees and live, hazard trees within 200 feet of the road will be directionally-felled towards the road and will then be cabled or winched to the road prism. Therefore, these activities have the potential to cause limited soil and understory vegetation disturbance through the action of log skidding. In addition, the harvest of dead, standing trees and live, hazard trees will likely result in a slight decrease in forest canopy cover.

The actual road maintenance activities associated with Alternatives 2 and 4 were already addressed above, because the effects of road maintenance on weeds under all four alternatives are similar.

Expected Direct and Indirect Effects of Project Activities

Through the action of skidding logs to the road prism, both Alternatives 2 and 4 could result in enough soil disturbance to create favorable germination conditions for some weed species. Additionally, existing weed infestations of spotted knapweed or St. Johnswort may have more potential to spread within the activity area, or even germinate from seeds long held dormant in the soil profile, because the log skidding could result in exposed, bare mineral soil. However, because the decrease in forest canopy cover from existing conditions is expected to be minimal, the likelihood of favorable light conditions for germinating weed seedlings to be successful or dominate is negligible. Furthermore, by eliminating the potential for off-road equipment to carry seeds of potentially new weeds or new invaders out into the salvage area, the potential for establishment of new species in activity areas is also negligible.

Over the long term, the loss of even minimal forest/tree canopy cover from implementing the proposed activities is considered temporary. As forest canopy recovers or increases following harvest, an area's susceptibility to weed infestation or weed spead decreases. This process could take 40-50 years. In areas with a high shrub component, recovery of the shrub canopy layer would be much quicker. For example, Merrill (1982) found that twig densities on ninebark increased through the third post-disturbance growing season and that shrub heights on burned and unburned sites were equal by the fourth season.

With the exception of spotted knapweed and St. Johnswort, all of the weed species documented in the project area were largely confined to existing road corridors, occur at low levels, and/or are confined to microsites of suitable habitat. Most of those weed populations are currently being managed or actively controlled through implementation of each district's noxious weed control policy. As stated above, additionally the requirement for harvest equipment to stay on road prisms should effectively eliminate the potential for weeds along the road corridor to spread off into the areas proposed for roadside salvage. Therefore, spread of oxeye daisy, sulfur cinquefoil, common tansy, Canada thistle, and hawkweeds away from the road corridors is not expected as a result of implementation of Alternatives 2 and 4, especially when implemented with design features.

Summary of Expected Direct and Indirect Effects

Based on past monitoring (see project file), successful weed treatment would remove the majority of new seed source for existing weed infestations, which occurs on roadsides, and would slow the spread of existing weed infestations within the project area.

Preventive seeding of native and desired nonnative species in areas of new disturbance would reduce the risk of weed spread. Continued treatment of existing weeds along haul routes on NFS lands would also reduce the risk of weed spread. Contract requirements to clean off-road harvest equipment prior to entry into the sale area would further reduce the risk of introduction of new weed species. The risk of introduction and establishment of new weed invaders to the project area is expected to be low with implementation of the required design features.

Weed prevention and treatment measures would reduce but not eliminate the potential for spread of St. Johnswort and knapweed within the project area.

Cumulative Effects

This section describes the cumulative effects that are expected as being specific to implementation of Alternative 2 and Alternative 4. All other cumulative effects of this alternative are described under Cumulative Effects Common to Alternatives 1, 2, 3, and 4.

Short-term cumulative effects regarding susceptibility to weeds would be associated with ground disturbing activities proposed under Alternatives 2 and 4. Design features (as described on page 11-12) would reduce but not eliminate the risk.

Proposed treatment of existing infestations on haul routes with approved herbicides and preventive seeding and monitoring along roads and landings, would greatly reduce the risk of transporting goatweed and spotted knapweed off-site.

Reasonably Foreseeable Actions

Noxious weed treatment and monitoring would follow guidelines established in the commensurate district's noxious weed control policy (USDA 1995, USDA 1997, USDA 1998.) Design features to reduce the risk of weed spread from project activities would complement past investments in weed management made by the Forest Service on roads in the project area. Forest roads to be used for hauling during implementation of the project would be treated as needed. In addition, Knutsen-Vandenberg (KV) funding from proceeds of the roadside salvage sale may be available to supplement appropriated funding for release of biological control agents in offroad infestations of spotted knapweed and St. Johnswort.

Weed treatment activities would be successful in controlling St. Johnswort and spotted knapweed along road prisms, but in the short-term would not have a significant effect on these species where they occur away from Forest System roads. These two species are considered naturalized in the project area, and would not be eradicated by weed treatment efforts.

The short-term management goal for St. Johnswort and spotted knapweed is to reduce the risk of seed and plant parts being transported out of the project area. The long-term goal is to reduce the size of infestations and slow the rate of spread within the project area. Based on past monitoring (see project file), continued treatment of existing infestations along roads in the project area would greatly reduce the risk of transporting these species off-site.

Determination of Cumulative Effects

When combined with all of the above activities, cumulative effects resulting from implementation of Alternative 2 or Alternative 4 with regard to existing weed infestations are expected to be low for oxeye daisy, common tansy, sulfur cinquefoil, Canada thistle, and hawkweeds based on their current levels of infestation.

Cumulative effects for spotted knapweed and St. Johnswort would likely be moderate, given their current levels of infestation. Off-road infestations of spotted knapweed and St. Johnswort would be expected to persist, since these species are considered to be naturalized in the project area. Treatment of off-road infestations with biological control agents may reduce the size of the infestations but would not eliminate them. Cumulative impacts to suitable habitat for this species would be low to moderate.

Compliance with the Forest Plan and Other Regulatory Direction

According to Forest Plan (USDA 1987) direction, infestations of many noxious weed species, including knapweed, St. Johnswort and common tansy, are so widespread that control would require major programs that are not possible within expected budget levels (Forest Plan, p. II-7). Forest Plan direction is to "provide moderate control actions to prevent new weed species from becoming established". The No Action alternative (Alternative 1) and Alternative 3 meet Forest Plan direction by not creating new disturbance conducive to new noxious weed invasions or spread of existing weed populations, off of existing, open road prisms. Alternative 2 and Alternative 4 meet Forest Plan direction by providing moderate control actions through project design, as required by the Forest Plan, to prevent new weed species from becoming established. It should be noted that, since the Forest Plan was implemented in 1987, the issue of weed infestations on NFS lands has evolved to encompass broader issues of native ecosystem integrity and the effects to non-commodity resources and ecosystem processes. The forest plan revision process will consider the increased emphasis on weed management.

Design features to reduce the risk of weed spread, described on pages 11-12, as well as in Chapter 2 of the EA, are as required in Forest Service Manual Chapter 2080, as amended (USDA 2001b.) In addition, several recommended, but not required, practices related to roads and timber harvest activities are also included in design features. FSM requirements and regulations related to noxious weeds are included in the project file.

According to Executive Order #13112 (1999), "Federal agencies whose actions may affect the status of invasive species, shall, to the extent practicable and permitted by law, identify such actions; subject to the availability of appropriations and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and not authorize, fund or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species…unless…the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that

all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

At the project level, noxious weeds have been identified and weed prevention measures incorporated into the proposed action. The potential for weed spread was disclosed for the proposed action.

References

Abella, Scott R. and Neil W. MacDonald. 2000. Intense burns may reduce spotted knapweed germination. *In:* Ecological Restoration. 18(2): 203-204. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Allen, Karen and Katherine Hansen. 1999. Geography of exotic plants adjacent to campgrounds, Yellowstone National Park, USA. *In:* The Great Basin Naturalist. 59(4):315-322. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Arno, Stephen F. 1999. Undergrowth response, shelterwood cutting unit. *In:* Smith, Helen Y. and Stephen F. Arno, eds. Wildland fire in ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42-vol. 2. USDA Forest Service Rocky Mountain Research Station. Ogden, UT. pp. 97-120. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Bedunah, Don and Jeff Carpenter. 1989. Plant community response following spotted knapweed (*Centaurea maculosa*) control on three elk winter ranges in western Montana. *In:* Fay, Peter K.; Lacey, John R., eds. Proceedings of the knapweed symposium; 1989 April 4-5; Bozeman, MT. Montana State University: 205-212. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Briese, D.T. 1996. Biological control of weeds and fire management in protected natural areas: are they compatible strategies? *In:* Biological Conservation. 77(2-3):135-142. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Briese, D.T. 1997. Population dynamics of St. John's wort: past, present and future. *In*: Jupp, Paul W.; David T. Briese; Richard H. Groves, eds. St. John's wort: *Hypericum perforatum* L. - integrated control and management: Proceedings of a workshop; 1996 November 13-14. Canberra, Australia. *In*: Plant Protection Quarterly. 12(2): 59-63. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Campbell, M.H. and E.S. Delfosse. 1984. The biology of Australian weeds. 13. *Hypericum perforatum* L. *In:* The Journal of the Australian Institute of Agricultural Science. 50(2):63-73. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

DiTomaso, Joseph M. 2000. Invasive weeds in rangelands: species, impacts, and management. *In*: Weed Science. 48(2)255-265. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Drlik, T.; I. Woo and S. Swiadon, editors. 1998. Integrated vegetation management guide. Bio-Integral Resource Center. Berkeley, California. 16 pp.

Executive Order 13112. 1999. Invasive species. Order by President Bill Clinton to prevent the introduction of invasive species and provide for their control. Signed February 3, 1999. Washington D.C.

Fire Effects Information System. 2008. Summaries of the biology, ecology and relationship of living organisms to fire. An online database at http://www.fs.fed.us/database/feis/plants/forb/.

Hammet, Anna E. 1999-2005. Personal observations of weed infestation levels on roads and old harvest units in the West Gold project area, noting an overall decline in population density of weed species along road prisms in the project area after initial and follow-up treatments. The West Gold project area has weed species composition and infestation levels similar to those in the Gold Crown project area. A summary is in the project file.

Hammet, Anna E. and Robert Klarich. 1996. Personal observations that oxeye daisy (*Leucanthemum vulgare*) has the ability to spread into areas with canopy reduction to below approximately 55 percent.

Harris, P. and R. Cranston. 1979. An economic evaluation of control methods for diffuse and spotted knapweed in western Canada. Canadian Journal of Plant Science. 59:375-382. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Harris, J.A. and A.M. Gill. 1997. History of the introduction and spread of St. John's wort (*Hypericum perforatum* L.) in Australia. *In:* Jupp, Paul W.; David T. Briese; Richard H. Groves, eds. St. John's wort: *Hypericum perforatum* L. - integrated control and management: Proceedings of a workshop; 1996 November 13-14. Canberra, Australia. *In*: Plant Protection Quarterly. 12(2):52-56. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Harrison, R.D.; N.J. Chatterton and R.J. Page [and others]. 1996. Effects of nine introduced grasses on ecological biodiversity in the Columbia Basin. *In:* Rangelands in a sustainable biosphere: Proceedings, 5th international rangeland congress; 1995 July 23-28; Salt Lake City, UT and Denver, CO. *In:* Society for Range Management. pp. 211-212. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Harvey, Stephen J. and Robert M. Nowierski. 1989. Spotted knapweed: allelopathy or nutrient depletion? *In:* Fay, Peter K and John R. Lacey, eds. Proceedings: knapweed symposium; 1989 April 4-5. Montana State University. Bozeman, MT. p. 118. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Hobbs, Richard and Stella E. Humphries. 1995. An integrated approach to the ecology and management of plant invasions. *In:* Conservation Biology. 9(4):761-770.

Lacey, John R.; Clayton B. Marlow and John R. Lane. 1989. Influence of spotted knapweed (*Centaurea maculosa*) on surface runoff and sediment yield. Weed Technology. 3(4):627-631. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

LeJeune, Katherine D. and Timothy R. Seastedt. 2001. *Centaurea* species: the forb that won the west. Conservation Biology. 15(6):1568-1574.

Maddox, D.M. 1979. The knapweeds: their economics and biological control in the western states, USA. *In*: Rangelands 1(4): 139-141. *In:* Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Maron, John L.; Montserrat Vila; Riccardo Bommarco; Sarah Elmendorf and Paul Beardsley. 2004. Rapid evolution of an invasive plant. *In*: Ecological Monographs. 74(2):261-280. *In*:

Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Merrill, E.H. 1982. Shrub responses after fire in an Idaho ponderosa pine community. Journal of Wildlife Management. 46(2):496-502. *In*: Noste, Nonan B. and Charles L. Bushey. 1987. Fire response of shrubs of dry forest habitat types in Montana and Idaho. General Technical Report INT-239. USDA Forest Service Intermountain Research Station. Ogden, Utah.

Noste, Nonan V. 1982. Vegetation response to spring and fall burning for wildlife habitat improvement. *In*: Baumgartner, David M., compiler. Site preparation and fuels management on steep terrain: Proceedings of a symposium; 1982 February 15-17; Spokane, WA. Pullman, WA: Washington State University, Cooperative Extension. pp. 125-132. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Noste, Nonan V. and Charles L. Bushey. 1987. Fore response of shrubs of dry forest habitat types in Montana and Idaho. General Technical Report INT-239. USDA Forest Service Intermountain Research Station. Ogden, Utah.

Ochsmann, Jorg. 2001. On the taxonomy of spotted knapweed (*Centaurea stoebe* L.). *In*: Smith, Lincoln, ed. Proceedings, 1st international knapweed symposium of the 21st century, 2001 March 15-16; Coeur d'Alene, Idaho. Albany CA: USDA Agricultural Research Service. pp. 33-41. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Olson, Bret E. 1999. Impacts of noxious weeds on ecologic and economic systems. *In*: Sheley, Roger L.; Petroff, Janet K., eds. Biology and management of noxious rangeland weeds. Corvallis, OR: Oregon State University Press. pp. 4-18. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Parendes, Laurie A. and Julia A. Jones. 2000. Role of light availability and dispersal in exotic plant invasion along roads and streams in the H.J. Andrews Experimental Forest, Oregon. *In*: Conservation Biology. 14(1):64-75. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Peck, J.H., C.J. Peck, D. R. Farrar. 1990. Influences of life history attributes on formation of local and distant fern populations. *In*: American Fern Journal 80(4): 126-142.

Powell, G.W.; B.M. Wikeem; A. Sturko and J. Boateng. 1997. Knapweed growth and effect on conifers in a montane forest. Canadian Journal of Forestry Resources 27(1997):1427-1433.

Rees, Norman E. Paul C. Quimby, Jr., Gary L. Piper, Eric M. Coombs, Charles E. Turner, Neal R. Spencer and Lloyd V. Knutson, eds. 1996. Biological control of weeds in the west. Western Society of Weed Science. Bozeman, Montana.

Ridenour, Wendy M. and Ragan M. Callaway. 2001. The relative importance of allelopathy in interference: the effects of an invasive weed on a native bunchgrass. Oecologia. 2001(126):444-450.

Roche, Ben F., Jr.; Gary L. Piper and Cindy Jo Talbot. 1986. Knapweeds of Washington. Washington Sate University, Cooperative Extension, College of Agriculture and Home Economics. Pullman, WA. 41 pp. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Ruggiero, Leonard F.; Lawrence L.C. Jones and Keith B. Aubry. 1991. Plant and animal habitat associations in Douglas-fir forests of the Pacific Northwest: an overview. *In*: Ruggiero, Leonard F.; Keith B. Aubry; Andrew B. Carey and Mark H. Huff, technical coordinators. Wildlife and vegetation of unmanaged Douglas-fir forests. General Technical Report PNW-GTR-285. USDA Forest Service Pacific Northwest Research Station. Portland, OR. pp. 447-462. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Sampson, Arthur W. and Kenneth W. Parker. 1930. St. Johnswort on range lands of California. Bulletin 503. University of California, College of Agriculture, Agriculture Experiment Station. Berkeley, CA. 47 pp. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Sheley, Roger L. and B.F. Roche. 1982. Rehabilitation of spotted knapweed infested rangeland in northeastern Washington. *In*: Western Society of Weed Science 31. Abstract. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Sheley, Roger L.; James S. Jacobs and Michael F. Carpinelli. 1998. Distribution, biology, and management of diffuse knapweed (*Centaurea diffusa*) and spotted knapweed (*Centaurea maculosa*). *In*: Weed Technology. 12(2):353-362. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Sheley, Roger L.; James S. Jacobs and Michael L. Carpinelli. 1999. Spotted knapweed. *In*: Sheley, Roger L. and Janet K. Petroff, eds. Biology and management of noxious rangeland weeds. Oregon State University Press. Corvallis, OR. pp. 350-361. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Sheley, Roger; Mark Manoukian and Gerald Marks. 2002. Preventing noxious weed invasion. MONTGUIDE MT 199517 AG 8/2002. Montana State University Extension Service. Bozeman, MT. 3pp.

Tisdale, E.W. 1976. Vegetational responses following biological control of *Hypericum perforatum* in Idaho. *In*: Northwest Science. 50(2):61-75. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Tisdale, E.W.; M. Hironaka and W.L. Pringle. 1959. Observations on the autecology of *Hypericum perforatum*. In: Ecology. 40(1):54-62. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/hypper/all.html.

Tyser, Robin W. 1990. Ecology of fescue grasslands in Glacier National Park. *In*: Boyce, Mark S. and Glenn E. Plumb, eds. National Park Service Research Center, 14th annual report. Laramie, WY: University of Wyoming, National Park Service Research Center. pp. 59-60. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Tyser, Robin W. and Carl H. Key. 1988. Spotted knapweed in natural area fescue grasslands: an ecological assessment. Northwest Science. 62(4):151-160.

USDA Forest Service. 1987. Idaho Panhandle National Forests Forest Plan. Coeur d'Alene, Idaho.

USDA Forest Service. 1995. Bonners Ferry Noxious Weed Control Project Environmental Impact Statement. Idaho Panhandle National Forests, Bonners Ferry Ranger District. Available at the district office.

USDA Forest Service 1997. Priest Lake Ranger District Noxious Weed Control Project Environmental Impact Statement. Idaho Panhandle National Forests, Priest Lake Ranger District. Available at the district office.

USDA Forest Service. 1998. Sandpoint Noxious Weed Control Project Environmental Impact Statement. Idaho Panhandle National Forests, Sandpoint Ranger District. Available at the district office.

USDA Forest Service. 1999. Northern Region Overview. USDA Forest Service Northern Region. Missoula, Montana.

USDA Forest Service. 2001a. Guide to noxious weed prevention practices. Version 1.0. Available online at http://fsweb.sanjuan.r2.fs.fed.us/range/fsweedprevention_070.doc.

USDA Forest Service. 2001b. Forest Service Manual 2080. Noxious weeds. Supplement No. R1 2000-2001-1. Northern Region. Missoula, Montana.

Watson, A.K. and A.J. Renney. 1974. The biology of Canadian weeds. 6. *Centaurea diffusa* and *C. maculosa*. *In:* Canadian Journal of Plant Science. 54: 687-701. *In*: Fire Effects Information System. An online database at http://www.fs.fed.us/database/feis/plants/forb/cenmac/all.html.

Whitson, Tom D., Larry C. Burrill, Steven A. Dewey et al. 1991. Weeds of the West. Western Society of Weed Science. Bozeman, Montana.